

CHAPTER 3

TRANSPORTATION STRUCTURES

3-1. Bridges

a. Highway. Design of highway bridges will be in accordance with the AASHTO Standard Specifications for Highway Bridges and American Institute of Steel Construction (AISC) Highway Structures Design Handbook. Loading for military vehicles will be in accordance with TM 5-312 and FM 5-36.

b. Railroad. Design of railroad bridges will be in accordance with the American Railway Engineering Association (AREA) Manual for Railway Engineering.

c. Pedestrian. Design of pedestrian bridges will consider a minimum live load of 85 psf and possible loads by maintenance vehicles as set forth in the AASHTO standard specifications. Such loads will be considered in conjunction with wind, snow, and other loads to which the structure may be subjected.

d. Other. Bridges for other specialized applications, such as pipeline supports, transit systems, etc., will meet requirements unique to such applications for the service involved and the materials used. For example, bridges constructed of aluminum will be designed in accordance with the Aluminum Association Specifications for Aluminum Structures using allowable stresses for bridges and similar type structures. For additional guidelines for concrete bridge structures, see ACI 343R.

3-2. Tunnels

Analysis and design for tunneling and tunnel structures will be based on the information and references provided in NAVFAC DM-7.3 and American Society of Civil Engineers (ASCE) 402. Structural strength and stability will be considered, as well as the need for ventilation and other services.

3-3. Docks and harbors

a. Design. Design of docks and harbors will, in general, be in accordance with the MIL-HDBK-1025 series which addresses waterfront operational facilities. Additional guidance may also be found in the NAVFAC DM-26 series and the Coastal Engineering Research Center (CERC) Shore Protection Manual, Volumes I through m. Specific requirements applicable to particular types of dock and harbor structures will be established from references specially suited to those types of structures such as MIL-HDBK-1025/3 and MIL-HDBK-1025/5. Particular consideration will be given to corrosion-resistant design in seawater environments. For guidance in this regard, refer to MIL-HDBK-1025/6. Wave forces on vertical walls, piles, and other exposed structures will be determined in

accordance with the CERC Shore Protection Manual. Site wave studies will be performed to determine the effect of wave action on structures.

b. Piers and wharves.

(1) *Main structure.* Design of main pier or wharf structures will consider conditions of exposure and loadings applicable to the location and service for which the structure is intended. A discussion of appropriate design loads can be found in MIL-HDBK-1025/1. Design loads will include considerations of vertical live load, berthing forces, mooring loads, wave loadings, ice forces, as well as seismic and other forces as appropriate.

(2) *Dolphins.* Dolphins will be designed as described in the MIL-HDBK-1025 series and will be provided where required to resist ship berthing, mooring, and/or turning forces. Guidance regarding the determination of berthing, mooring, and turning forces is also provided in the MIL-HDBK-1025 series.

(3) *Fendering.* Fender systems will be designed to protect the pier or wharf structure, as well as the berthing vessel itself, from forces which can result from the impact of the vessel against the structure. Design of fender systems will be in accordance with MIL-HDBK-1025/1 for vessel sizes appropriate for the structure and for the recommended approach velocity and angle.

c. Offshore platforms. Offshore platforms will be designed considering requirements and loadings set forth in the MIL-HDBK-1025 series and the CERC Shore Protection Manual and will be designed in conformance with applicable portions of the American Petroleum Institute (API) RP 2A. For additional design guidance, see ACI 357R, 357.1R, and 357.2R.

d. Offshore POL unloading facilities. Design of offshore POL unloading systems will be in accordance with NAVFAC DM-22. Wave studies will be made for the design of the mooring system and platforms. Submarine pipelines will be properly designed and anchored against undersea current and underwater tow.

3-4. Pipelines and supports

Design requirements for pipelines and their supports will depend on the nature of the material being transported and the materials used for construction. Among the standards which should be consulted when undertaking design of pipeline systems are the following:

a. American Society of Mechanical Engineers (ASME) B31.8.

b. American Petroleum Institute (API) Standard 1104 and Recommended Practices 1102 and 1110.

TM 5-809-6/AFM 88-3, Chap. 6

c. American Society of Civil Engineers (ASCE) Publications 368, 418, and 428.

d. American Water Works Association (AWWA) Publications M9 and M11.

e. American Concrete Institute (ACI) 346 and 346R.
When necessary, reference may be made to appropriate publications of specialty associations such as the American Concrete Pipe Association (ACPA) and the American Concrete Pressure Pipe Association (ACPPA).